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ABSTRACT

A learner who is not positively disposed to, or has a socio-cultural background that is indifferent to, learning science would find it hard to learn science effectively with the right attitudes. This study investigated if instruction through the use of the socio-cultural mode has any significant effect on a student's attitude towards the learning of science. The sample consisted of 600 senior secondary year one (grade 10) students from 15 selected secondary schools in Nigeria. The Socio-Cultural Environment Scale (SCES) and the Biology Achievement Test were used to measure the change in attitude and achievement of subjects in a pre-/posttest situation after 6 weeks of treatment. Evidence was found to support the hypothesis that science instruction which deliberately encompasses the discussion of socio-cultural views about science concepts engenders positive attitudes towards the study of science. The findings also indicate that a harmonious coexistence could be generated for both the anthropomorphic and mechanistic views in such a way as to promote positive attitudes towards the study of science in traditional cultures. Lists 27 references. (Author/YP)

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THE EFFECT OF INSTRUCTION ON SOCIO-CULTURAL BELIEFS HINDERING THE LEARNING OF SCIENCE BY A SAMPLE OF NIGERIAN STUDENTS.

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Abstract

Although recent studies have shown that the socio-cultural characteristics which children in non-western society bring into the classroom from their environment create a wedge between what they are taught and what they learn, very little has been done to solve the problem.

A learner that is not positively disposed to, or has a socio-cultural background that is indifferent to, learning science would find it hard to learn science effectively with the right attitudes.

This study investigated if instruction through the use of the socio-cultural mode has any significant effect on students' attitude towards the learning of science.

The sample consisted of 600 senior secondary year one students (442 boys, 156 girls) from 15 selected secondary schools in Nigeria. The Socio-Cultural Environment Scale (SCES) and the Biology Achievement Test were used to measure the change in attitude and achievement of subjects in a pre-posttest situations after a six-week treatment.

Evidence was found from the study to support the hypothesis that science instruction which deliberately encompasses the discussion of socio-cultural views about science concepts engenders positive attitudes towards the study of science. The findings also indicate that a harmonious coexistence could be generated for both the anthropomorphic and mechanistic views in such a way as to promote positive attitudes towards the study of science in traditional cultures.

Introduction

Human beings since the early times have always interpreted nature from the two distinct view points of anthropomorphism and mechanics (Ogunniyi, 1988). The dominance of either of these worldviews in any society is dependent on the socio-cultural formation of such a society. A socio-cultural grouping of individuals is characterised by a commonality in their values and an appreciation of beliefs, customs, myths, etc. These characteristics, amongst many other factors, regulate the everyday life of a person within the traditional society and consequently govern the worldview of natural phenomena.

Indeed, since every society educates the younger generation as a means of passing down the socio-cultural attributes of its people, the socio-cultural factors within non-western societies become a composite part of the environment and therefore control to a very large extent what a child in such an environment learns and becomes in later life. Since every human"tends to resolve puzzles in terms of the meanings available in a particular socio-cultural environment, the baseline is that the meanings become firmly implanted in the cognitive structure and manifest themselves habitually and may act as templates, anchors or inhibitions to new learnings" (Ogunniyi, 1988).

Several people have alluded to the fact that culture has a lot to do with achievement differences in school work (Boas, 1911; Horton, 1964; Hoebel, 1965; Erickson, 1984). With respect to school science learning, Bajah (1975), Ehindero (1982), Ogunniyi 1982), Driver (1979), Kay (1975), Johnson (1970), Jegede (1987), Okebukola and Jegede (1987) and Jegede and Okebukola (1988, 1989) have attributed the deficiency in science achievement and the attainment of excellence to the militating effects of socio-cultural factors.

The call for studies to illuminate the role which socio-cultural factors play in science learning in non-western cultures has led to the identification and isolation (Jegede, 1987; Jegede and Okebukola, 1988) of five main factors of **authoritarianism, goal structure, african worldview, societal expectation** and **sacredness of science.** These factors relate to (i) the general environment in which the learner spends most of his/her time (authoritarian/democratic), (ii) goal structure preference for cooperative, competitive and individualistic work, (iii) the reasoning pattern dictated by

the traditional society (empirical or mythical), (iv) the nature of interaction within a communal society and its influence on the success or otherwise of an individual (societal expectation), and (v) the knowledge system within a traditional society which regards science as a magical, weird and something special . Jegede and Okebukola (1988, 1989) found in their studies that authoritarianism, african worldview, societal expectation and sacredness of science have negative effects, while goal structure exerted a positive effect on the learning of science in Nigerian classrooms.

The obvious implication of the above is that, regardless of how adequate the conditions for teaching science are in our classrooms, the socio-cultural characteristics which children bring into the class from their environment create a wedge between what they are taught and what they learn. If, as (Novak, 1988) found, the recent worldwide developments in science education have really not contributed signficantly to effective science learning, it is not too difficult to imagine how the influence of the socio-cultural environment would compound the effects of the totality of science education endeavour.

As a way to begin to combat this debilitating phenomenon, Abdullahi (1982), Ukoli (1985), Bajah (1986), Black (1984), Ogawa (1985), Ogunniyi (1986) and Jegede and Okebukola (1987) have in their various write-ups called for science instruction that would (a) structure the classroom environment in a way that the cultural variables of the learner could be utilised to the maximum and (b) recognize the characteristics of the learner's socio-cultural background as well as the load of burden which they bring into the clasroom environment that might serve as a blockage to fruitful learning of science concepts.

Learning leads to a change in behaviour and attitudes. A learner who is not positively disposed to or has a socio-cultural background that is indifferent to learning science in the classroom would find it difficult, if not almost impossible, to effectively learn science with the right attitudes. If it is agreed that whatever students learn in a science classroom is done through the framework of scio-cultural filters, then it is necessary to provide empirically based information on the influence of specifically tailored instruction on the socio-cultural attitudes of learners. The provision of such potentially valuable data motivated this study. Specifically, this study investigated:

(a) whether instruction in selected science concepts through the use of socio-cultural mode has any significant effect on students' attitudes towards the learning of science ; and

(b) if gender has any significant relationship with students' socio-cultural attitudes towards the study of science in a non-western environment.

Methodology

Sample

A total of 600 students (442 boys, 158 girls) of senior secondary year one (grade level 10) from 15 secondary schools in Nigeria served as the subjects for the study. These schools are located in 9 out of the 21 states of the Federation. The choice of the 15 schools used was basically purposive as the volunteer teachers drawn from a group of long vacation term degree students who were in their final term at Ahmadu Bello University, Zaria used their schools for the experiment. The 15 teachers, who have taught biology for at least 5 years each, were part of a B.Sc Education final year students who have run their degree course over a period of four long vacations. A request for volunteers was made to the students by the senior author after explaining the purpose of the research and stating the conditions of the study. These conditions include (i) the teacher must have taught Biology at the High School level for a continuous period of at least 5 years, and (ii) willingness on the part of the volunteer teacher to reorganize the scheme of work and syllabus for the term during which the study would be conducted according to the design of the study.

In each school, two classes of the senior secondary year one (grade level ten) were selected by random sampling technique and assigned as experimental and control groups respectively. The total number of subjects for each of the experimental and control groups for the study was 300 students. The senior secondary year one (grade level 10) was used for the study because the biology topic chosen for the research was part of their syllabus for that academic year.

Instrumentation

The data were collected using the Socio-Cultural Environment Scale (SCES) developed and validated by Jegede and Okebukola (1988). The validation of the instrument went through a series of stages using a panel of sciene educators, science teachers, sociologists and anthropologists to determine construct and content validity. The SCES is a 30-item instrument with the five subscales of authoritarianism, goal structure, african worldview, societal expectations and scacredness of science. Respondents were asked to indicate their agreement with each item on the SCES by a choice of "never, "sometimes" or "often" on a 3-point scale scored as 1, 2 and 3. Negative items had thier scores reversed in like manner. The alpha reliability coefficient for the five subscales of the SCES determined for the experimental subsample of the study ranged from 0.88 to 0.98. The Biology Achievement Test consisting of 50 multiple choice items assembled from standardized past question papers of the West African Examination Council was administered as a covariate for the attitude change. The reliability co-efficient of the BAT using the Spearman-Brown split half was found to be 0.79.

Design and Procedure

A pretest-posttest experiment with random assignment of subjects to experimental and control groups in each school, using the class as a unit, was used to examine any possible treatment effect due to exposure to the socio-cultural teaching mode.

In addition to the collection of quantitative data from the sample on the experimental effect of the instructional intervention, individual interviews with a subset of the experimental subjects were conducted to provide a comprehensive and richer picture of just what is happening in terms of changes in socio-cultural beliefs of the students. A total of 18 students (10 males and eight females) in the experimental group of two senior secondary schools were interviewed by the senior author on a one-to-one basis.

The interviews with the individual students lasted from 20 to 35 minutes depending on the details of their responses. Interviews were partially open-ended and was guided by some structured interview questions. One of the major determinants of the choice of questions was an attempt to zero in on their attitude change vis-a-vis their socio-cultural views about the biological concepts they were taught. The interview schedule therefore included such questions as:

1. Did you find the lessons different from what you were used to? If so, give reasons for your answer
2. Would you prefer your teacher to continue with this method of teaching biology concepts?
3. Mention the things that you like very much with the method your teacher used in teaching the biology concepts.

The responses of the students to these and other questions were analysed and have been incorporated into the discussion of the results.

Fifteen biology teachers enrolled for the long vacation term degree course at the Ahmadu Bello University, Zaria participated in the experiment. The teachers, who were all in their final year of the part-time study, spent two weeks with the senior author as an orientation period for the preparation towards the study. The two-week period afforded the teachers the opportunity to discuss and learn in detail what socio-cultural factors are and their effect in science learning; become familiar with the SCES; understand the rationale and go through details of the proposed design of the experiment; make a choice and go through the syllabus topic to be used with the treatment and how to teach the topic using socio-cultural mode as a filter. Three micro-teaching sessions with two demonstration periods of 40 minutes in a near by senior secondary school were also used to supplement the teachers preparation for entry into the research situation.

After some discussion between the volunteer teachers and the senior author, the choice of the syllabus topic of Mammalian Reproduction was unanimously made as suitable for the experiment mainly because it is one of the topics for which children are not normally allowed by elders to discuss freely at home and would arouse great enthusiasm in the subjects.

In the 15 schools, both the experimental and the control groups had instruction on the same subtopics related to Mammalian reproduction for a period of six weeks by the 15 teachers who participated in the study. The topic was broken down into the subtopics of (a) what is a mammal? (b) the male reproductive system (c) the female reproductive system (d) fertilization, implantation and gestation (e) birth, parental care and birth control and (f) revision and assessment. To aid the teaching, rabbits were dissected for the study of the reproductive systems while opaque projectors were used to show the developmental stages of foetus in addition to the construction of models of the foetal stages by the students under teacher guidance.

In the experimental group, the treatment consisted of teaching the subjects the subtopics which incorporated planned teacher-students discussions of the socio-cultural (mythical, superstitious, etc.) beliefs about some biological ideas and concepts. These were done for about a quarter of every teaching period to determine their validity in relation to what was learnt in the biology lessons during the treatment. The teacher-students discussions in the treatment group focused on the analysis of the major concepts of the lessons and what the beliefs in the society about the concepts are. The class were guided by the teacher to evaluate the traditional beliefs in the light of the information presented in the biology lessons. They were encouraged to further question the basis for these beliefs in relation to the tradition of science. Examples of these beliefs are: (i) an uncircumcised expectant mother would not give birth safely to the baby. In some African societies women are normally circumcised before marriage or just before delivery. This is ostensibly to appease the gods to allow safe delivery of babies.(ii) mating in the daytime gives rise to an albino; and (iii) a pregnant woman who sweeps in the night would give birth to a deformed baby.

The socio-cultural mode was not used for the control subjects. Instead, instruction followed the expository strategy in which the subtopics were taught strictly in compliance with the teaching notes of the syllabus.

At the end of the treatment period, both the experimental and control subjects were given an equivalent of a two and a half hour review of what has been taught during the period of the experiment. This was followed by the administration of the SCES instrument and a Biology Achievement Test (BAT) to all the subjects as posttests in the same way as a pretest was administered to them before the treatment. The administration of the SCES posttest was delayed for a period of six weeks after the treatment to check if the students attitude did revert back to the original state before the treatment.

The administration of the pretest and posttests was done during a normal lesson period of 40 minutes each. The average time taken by all the subjects to complete the instruments were 34 minutes (SCES) and 30 minutes (BAT) respectively.

Findings

A preliminary t-test revealed no significant difference between the mean pretest scores on the socio-cultural attitudes of experimental and control groups, thus establishing group equivalency on the dependent variable being measured as shown in Table I. The t-test carried out on the mean posttest SCES scores however indicated that the experimental group subjects (with a mean score of 45.72) significantly developed more positive attitudes than their control group counterparts who obtained a mean score of 34.34 ($t(598) = 9.25$, $p < .01$). Similarly, the t-test analysis on the biology achievement test mean scores of the two groups indicated that the experimental group significantly achieved better than the control group ($t(598 = 7.01$, $p < .01$).

TABLE I ABOUT HERE

In order to further confirm the existence of the significant treatment effect on, and the magnitude of the change in socio-cultural attitude of, the experimental group, analyses of covariance using the SCES pretest and the BAT test scores as covariates were undertaken. Analysis of covariance adjusts for initial differences betwen groups and for correlation between means. It also allows for comparison of groups on one variable when information is available on another variable correlated with it (Isaac & Michael, 1972). The results on Table II show significant mean differences between the control and experimental groups in both the SCES and biology achievement ($p < .01$). Significant gender differences were also noticed when achievement scores were used as covariates. The results seem to indicate that the positive change in the socio-cultural attitude of the experimental group as a result of the instructional intervention is very large and significant.

TABLE II ABOUT HERE

Discussion of Results

The major aim of this study was to investigate if an instructional intervention programme could tilt students' socio-cultural attitudes towards science learning positively. It also sought to find out if gender has any relationship with the development of the socio-cultural attitudes in the learning of science. Experimental evidence obtained in the study indicated that instruction in science deliberately planned to encompass discussion of socio-cultural views about science concepts engenders positive socio-cultural attitudes towards the study of science. Some of the students' responses to the interview questions do support this assertion. Examples of some of the typical statements made by a cross-section of the students include the following:

> "..the discussions about the superstitious beliefs surrounding the biology we learn at school allows us to give our opinions without being afraid".
>
> "...the discussions made me to enjoy the lessons more and I was able to learn a lot more from them."
>
> "..my attitude toward what science says about our traditioinal beliefs is now better".
>
> ".. I think I learned biology better now. I can see there is no clash between what I learn in school and what my people belief".

A parsimonious explanation for this finding could be that the teaching of science using the socio-cultural mode as filter serves to eliminate the apparent mismatch between the information and ideas brought into the science classroom from the traditional society and the scientific explanation of natural occurrences. In addition, the development of any attitude begins with a change in a currently held attitude. The results of this study therefore re-affirm the efficacy of instruction as a potent tool for attitude and behaviour change.

It would appear therefore that several other areas of the Senior Secondary School biology curriculum, for example, topics relating to health and the environment, human physiology, etc., could be taught this way. Significant among the students' interview responses supporting this view are:

> ".. we should always get a chance to compare the science ideas we learn in school and what our parents tell us at home".
>
> "..the teacher should not use this method to teach only reproduction, he should use it to teach all our biology lessons. And it should begin all the way from the junior secondary school".

An aspect of the findings which is perhaps a glimse into a potentially rewarding vast area is the indication that a harmonious coexistence could be generated for both the anthropomorphic and mechanistic views in such a way that promotes positive attitude to the study of science in non-western cultures. As mentioned by Ogunniyi (1988) and reinforced by the call for a holistic view to learning by Chen and Novik (1984) and Zeidler (1984), the tendency to reject any information that might cause mental disequilibrium or a change in attitude and hence to withdraw to our former self is always there. But it is this same tendency that science instruction should rechannel to a more positive end. Some of the statements made during by students during the interviews also corroborate this. For example, they stated that:

> ".. I can now see the science about what our parents tell us at home."
>
> "..the things about superstition and science knowledge in school are in two separate areas."
>
> ".. but, sir, is it really true that all the traditional belief about the science we learn in school are false ?"

The findings also show that gender does not significantly relate to students cultivation of positive attitudes towards the study of science instructed through the socio-cultural mode. This is as expected since, irrespective of gender, all individuals within a particular environment, particularly the traditional non-western one, process information regarding their socio-cultural characteristics in a similar manner. However, the differential effects between males and females in relation to achievement as found in this study appears to support the already documented superiority in science achievement of males over females.

Although it would appear injudicious on the basis of one sample and other experimental biases to conclude definitely that instruction through the socio-cultural mode significantly influence students' attitude towards the study of science, it does nevertheless illuminate this aspect of knowledge which, as far as we know, has never been investigated previously. A cautious acceptance of the conclusion arising from this study is therefore advised.

Some important implications arise from the findings of this research. First, science teachers and curriculum developers need to recognise the role that instruction through the socio-cultural mode plays in the development of positive attitudes towards the learning of science in traditional societies. Second, as suggested in reviews (Novak, 1988; Okebukola and Ogunniyi,

1984) and contrary to the wide belief, the way and manner in which science is being taught in contemporary times provides little insight into the process of knowledge construction. It stands to reason that such a novel way of communicating science in a traditional environment may hold some promise. Third, the findings of this study support the Ausubelian (1978) dictum that 'the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly' and reinforces the need for its full incorporation into all educational practices and research. Fourth, this study supports the call by Novak (1988) for more research to be carried out to ascertain the relationship between alternative instructional programmes and their impact on students' shift toward constructivist views. For learners within a non-western environment where socio-cultural impediments in the study of science arise, the determination of the epistemological commitments of students in learning is *sine-qua-non*.

The results of this study indicate a significant shift towards positive socio-cultural attitude in the learning of biology. Is the effect causal, relational or infact due to some other variables? As the students indicated through some of their statements quoted above and the following :

> ".. I want to be able to convince my parents not to accept the traditional beliefs but they will tell me I am not a true African".
>
> ".. my tradtional beliefs do not really affect my science study",

it may well be that something else, in addition to what has been found out in this study seems too be happening. It would therefore be appropriate to suggest the need for further study to determine the role and place of (traditional) worldviews in science education particularly in non western cultures like Nigeria.

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TABLE I

Means, standard deviations, t-tests on the pre - and post test mean scores on SCES for the control and experimental groups

	Control (N=300)		Experimental (N=300)		t	p<
Test	Mean	S.D	Mean	S.D		
Pretest	34.87	6.47	35.11	5.37	.49	n.s
Posttest	34.34	6.32	45.72	5.32	9.25	.001*
Achievement						
Posttest	23.70	8.48	29.00	9.99	7.00	.001*

* significant at p< .01

TABLE II

ANCOVA results for group (experimental/control) and gender differences in posttest scores on the SCES and BAT

Source of variation	Sum of squares	DF	F	Sig. of F
SCES pre-test scores as covariates				
Group (exp'al / control)	1490.32	1	46.93	.001*
Gender	68.48	1	2.16	.14
Group x Gender	.11	1	0.62	.78
Achievement scores as covariates				
Group (exp'tal / control)	4208.20	1	49.01	.001*
Gender	106.67	1	4.26	.01
Group x Gender	996.62	1	11.82	.01*

* significant at $p < .01$